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THE IMPACT OF NATIONAL CULTURE ON BUSINESS INTELLIGENCE MATURITY MODELS

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Research-in-Progresss

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Abstract

Maturity level modeling has been a well-established and important stream of IS research. Maturity models have played a significant role in guiding organizational process improvements in many areas. It is therefore surprising that maturity model design and development methodologies have not yet been scrutinized from cross-cultural and international perspectives. In this research, we have prescribed a rigorous approach to identifying, validating and calibrating maturity models constructs for cross-cultural application. We have employed this new methodology in the context of widely accepted business intelligence maturity model that has been initially developed in Germany. Our current effort involves following our proposed methodology to target and calibrate those nationally specific model components that need modification and calibration for application in the US. We report on our progress, and we discuss implications in terms of both findings relevant to culture in IS research, maturity model methodology research and BI maturity model research.

Keywords: Business intelligence (BI), National differences, Cross-cultural issues/cultural differences, Information systems evaluation, Internationalization,

Introduction

Maturity models have become an important mechanism for assessing an organization's current state and for targeting areas for improvement (Mettler et al. 2009). They have been widely applied in information systems (IS) departments. However, little research has been directed at the interplay between national culture and IS-oriented maturity models: a substantive omission given that IS has been credited with being an enabler of the global economy. This gap stands in contrast to other IS research streams where many international and cultural aspects have been addressed.

In general, scholars have established challenges related to the culture research stream in IS including: 1) Prior studies of culture's influence on IS use were limited because they under-addressed interactions with national or sub-culture values and how those interactions influence behaviors, 2) Individual disposition needs to be a factor when considering the impacts of culture on IS outcomes, 3) Little research has examined the bilateral impact of culture on IT and the impact IT can have on culture, 4) Studies need to view culture as contested, temporal and emergent, and 5) A long term orientation is missing from the literature (Gaspay et al. 2008; Leidner et al. 2006; Myers et al. 2002). Business Intelligence (BI) maturity provides a unique lens for addressing these challenges.

BI maturity assessments both reflect and impact an organization's decision making culture. This bilateral interrelationship provides an important lens for advancing the culture research stream. BI represents an organizational investment, yet individual managers rely on BI to perform their jobs (Popovic et al. 2009). BI also plays a role in control and monitoring. For these reasons, the work of management theorists who postulate that different cultural values imply predisposition to the deployment of certain types of communication and control patterns within firms can serve as a reference discipline – and vice versa (Aguilera et al. 2003). BI can also support root cause analysis. This opens a window into individual, group and firm problem solving.

Many papers argue that national culture influences IS development, use, success, etc. It seems likely that it also has an impact on BI solutions. Such interdependencies should be considered, for example, when designing global BI solutions in multinational organizations. Deploying BI applications, architectures, processes, etc. worldwide requires knowledge about national specificity in order to choose between global, standardized solutions versus local, diverse approaches. Insights about the interdependencies between national culture and BI as a subset of contingency factors also help to interpret research findings, in particular to assess their generalizability for different national cultures. Similar argumentation can be applied to the impact of national culture on BI maturity models. If this assumption can be verified, it leads to several consequences: A BI maturity model might not work the same for all countries, and this would require adaptations to become applicable in the international context. According to (de Bruin et al. 2005), maturity models can be descriptive, prescriptive, or comparative (i.e. enabling benchmarks across industries or regions). To make a maturity model comparative internationally requires knowledge about the aforementioned assumption. Therefore we have to answer the following research question:

(R 1) *How can national culture be considered in the development and application of a maturity model?*

We are particular interested in the role of national culture in the context of BI:

(R 2) *Is there an impact of national culture on BI maturity models?*

We will answer the first research question by extending an existing maturity model development framework. Applying this extension to an exemplary BI maturity model helps us to address the second research question.

Foundations

Business Intelligence maturity models

Few BI maturity models have originated in the scientific community (Aho 2009; Sen et al. 2006; Watson et al. 2001). The majority have been developed by vendors (e.g. Hewlett 2009; SAS Institute 2009; Töpfer 2008), by (market) research institutions (Eckerson 2007; Rayner et al. 2008), or in academic and industry collaboration (Cates et al. 2005; Chamoni et al. 2004). Existing BI maturity models still exhibit some shortcomings. Only the scientific models and (Chamoni et al. 2004) document some or all of the development process - a deficit that is shared with maturity models in general (cf. Becker et al. 2009; de Bruin et al. 2005). Also, very few BI maturity models

(Popovic et al. 2009; Sen et al. 2006) conduct at least some empirical evaluation of the model, but those evaluations have not validated the impact of BI maturity on (organizational) performance. In addition, none of the aforementioned maturity models consider contingency factors either in general, or specific contingency factors related to national culture. This is surprising as (Mettler et al. 2009) and others argue for the situational development of maturity models in order to take an organization's contextual factors into account. Our approach addresses this current omission of possible national contingencies in formulating and applying maturity models.

National culture

Maturity model contingencies hinging on national culture remain under-addressed, but culture issues have been addressed in the extant IS literature. Culture can be understood as the collective programming of the mind that distinguishes the members of one group or category of people from others (Hofstede et al. 2005). Accordingly, national culture is a concept that helps determine similarities and differences between the cultures of countries. Perhaps the best-known research in the area of objectively characterizing national culture is presented by (Hofstede et al. 2005) who identified five different dimensions of national culture (cf. later in more detail). Each dimension is "an aspect of culture which can be measured relative to other cultures" (Hofstede et al. 2005, p. 23).

Despite some limitations most of the IS research about the effects of national culture has relied on Hofstede's dimensions to validate propositions relating a variety of IS issues (Myers et al. 2002). For a comprehensive literature review about national culture and IS research in general we refer to (Leidner et al. 2006) and for a review regarding the work based on Hofstede's theory to (Gaspay et al. 2008). In addition, the management literature has a rich tradition of both contingency modeling and cultural implications (Aguilera et al. 2003) that might be considered. In this research, the unit of analysis is typically at the firm level. Research streams address control and monitoring differences in organizational structure and reporting patterns/requirements. In general, very few authors address the impact of national culture on BI (to the best of our knowledge no previous work examines this topic in detail), and there is certainly a dearth of work on culture in BI maturity model research. Also, only some preliminary work exists about the national specificity of maturity models for other domains (e.g. Dabhilkar et al. 2007; Ray et al. 2006), however with partially contradictory findings. This motivates even more the need to examine the potential impact of national culture on a BI maturity model.

Development framework for a comparative maturity model

Most maturity models are based on five maturity levels as consistent with the Capability Maturity Model (CMM) and many have constructs that are multidimensional. Hierarchical maturity models include categories within each dimension. We refer to the most granular unit of analysis for maturity models as a 'design object.' We call design objects that are described by characteristics that are influenced by national culture 'nationally specific design objects'; those not influenced by culture, we refer to as 'universal design objects'. For the design of a maturity model (Becker et al. 2009) and (de Bruin et al. 2005) suggest each a development framework with slightly different phases to be conducted. A complete discussion of development frameworks is beyond the scope of this paper, however, there are little, if any, stated processes, procedures or formalisms for maturity model development that specifically take into account possible national culture contingencies. Basically, there is no attempt to differentiate universal design objects from those that may be contingent on national culture.

In the face of these shortcomings we suggest to extend existing development frameworks to make a maturity model comparative internationally. With such a modification of an existing artifact, we aim at the construction of a better IS-related problem solution. Therefore, in this stage our research process adheres to the design research paradigm as outlined in (Hevner et al. 2004). We draw upon prior knowledge (maturity model development processes, national culture research findings, etc.) and build an artifact attributed to 'method', i.e. a guideline that is used to carry out activities toward a goal, which in this case is the development of a comparative maturity model. We have chosen to evaluate the method (extension) by an action research project. The application of the extended development framework to an existing maturity model helps to assess if the artifact meets the criteria of utility, quality, and efficiacy (Hevner et al. 2004). In addition, it allows us to gain insight about the relationship between national culture and BI (cf. research question R 2). The evaluation will be described in detail in the second part of the paper at hand.

We suggest to add three phases to the aforementioned maturity model development frameworks. Figure 1 exemplifies such an extension to an existing design process (in this case to de Bruin's framework) which results in

its original form in a descriptive or prescriptive maturity model. We assume that the maturity model to be made comparative already exists, so new phases are included at the end. Of course, national specificity could (or should) be considered as well when building a new maturity model from the scratch. In such a case, the activities as described in the following subsection would simply need to be integrated into earlier design phases (mainly design and populate phases in de Bruin's framework). For exposition brevity, we will describe the extension phases for two countries and assume that the maturity model was developed in one of the two countries. The phases can easily be generalized to more countries.

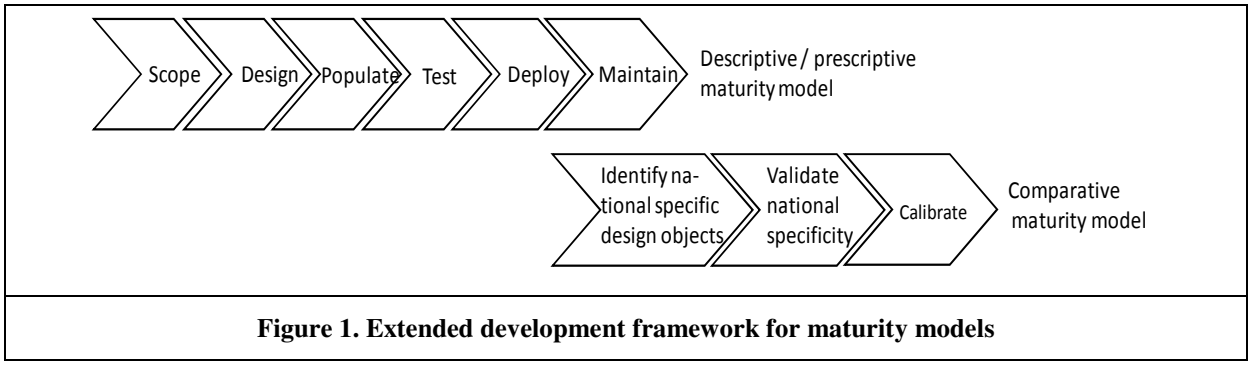

Figure 1. Extended development framework for maturity models

Identification of potentially national specific design objects

The intent of this first additional phase is to identify a subset of design objects from the extant set of all design objects present in a maturity model developed in the origination country. This subset represents a hypothesized set of *potentially* national specific design objects regarding the two countries (the 'origination' country and 'destination country' with regard to the transfer of the maturity model). In order to generate this set, we recommend reusing prior national culture findings where possible. For example, the aforementioned Hofstede indices can be used to capture the relevant aspects of national specificity. In the case of BI, these indices might be complemented by extrapolating from reference research in the management domain that is related to organizational contingency models reflective of national culture considerations (cf. Aguilera et al. 2003). This phase also requires a clear understanding of the design objects of the maturity model. The main results of this phase are hypotheses about the impact of national culture factors on design objects for each country. By abstracting from the many previous studies about national culture, the set of potentially nationally specific design objects can be derived by comparison, argumentation and/or be based on the results of related work. The objective is to build sufficient knowledge base over time to support identifying those design objects most likely to be influenced by culture.

The unit of analysis in this phase should be the design object, and not any aggregated values or perspectives for categories or even dimensions within the maturity model. This is because the potential re-calibration of the maturity model in the third phase will be performed on the lowest level of granularity. Also, analyzing aggregated values includes the risk that impacts in the opposite directions on lower level objects might not be visible anymore on the higher level. It is also recommended to focus on national culture factors that are supposed to be significantly different for both countries in order to reduce complexity. We later present an example for the derivation of the hypotheses.

Validation of national specificity

In this validation phase the potentially national specific design objects will be examined in a pairwise fashion across the origination and destination countries, where the originating country is where the maturity model is first created, and the destination country is where the model is to be ported. Such a validation of the potentially national specific design object set (as hypothesized in the previous phase) requires empirical data. Consequently, an assessment or measurement instrument for the maturity model is needed, e.g. in form of a questionnaire. If it is not available, the model and its design objects have to be operationalized so they can be addressed in a survey. This questionnaire should also include items that measure the success of the domain addressed by the maturity model (e.g. BI, business/IT alignment, etc.). The reason for that will be motivated later in this subsection. Finally, if the maturity

model is described by a maturity grid or is CMM-like, the characteristics of design objects and corresponding answer options in the survey need to be clearly assigned to maturity levels. It allows the later codifying of the answer options in the questionnaire by numbers (typically on a 1 to 5 scale).

The subsequent data collection in both countries should follow well-known principles for empirical studies. The data constitute the input for the following empirical analyses which aim at testing the hypotheses about national specific design objects. First of all it has to be shown that the maturity model 'structure' (i.e. its dimensions, categories, etc.) is applicable in both countries. Therefore, if the maturity model is multidimensional or hierarchical (and most models are) then its structure should be analyzed in a first step regarding reliability and validity for both countries separately. This is typically conducted by calculation of Cronbach's alpha and an explorative factor analysis – a step which has to be performed for both countries. The results might already provide directions how to revise the maturity model for the second (destination) country. If the maturity model structure seems to not fit the second country, then it might be worth thinking of not continuing with the following steps. In such a case there seem to be fundamental national specific differences that might not be eliminated by simply re-calibrating the maturity model. In other words, the approach to compare the maturity between both countries using this model might fail – or may require another maturity model approach.

The measurement equivalence across countries should be tested as well, e.g. according to (Douglas et al. 1983) who distinguish calibration equivalence, translation equivalence, and metric equivalence. The purpose of the following step is to test the hypotheses (i.e. the assumed national specificities of the maturity model design objects). Just comparing the mean scores of maturity levels for each design object in each country would be too simple. Different characteristics for a design object in both countries do not necessarily mean that they can be attributed exclusively to national culture effects. Also a difference in the maturity for this design object between two countries can cause those different characteristics. Consequently, we also have to consider the success of the maturity model domain when analyzing the data. Therefore, empirical analysis should lead to the following disjoint classification of design objects as the main result of this phase (cf. Table 1):

Table 1. Classification of design objects

	High impact on success	**Low impact on success**
National specific	<Design object 1> …	<Design object 1> …
Universal	<Design object 1> …	<Design object 1> …

If the distinction "high impact / low impact on success" should be included in the classification depends on the fact whether such an analysis was already performed in a previous step of the maturity model design process. In such a case it should be checked if these results can be transferred to the second country. The above mentioned development frameworks do not address this topic in particular. To include design objects in maturity models that do not have impact on success can perfectly make sense. Especially if the maturity model has a descriptive character, then also these design objects might be of interest for organizations. In this case, however, it is important for organizations to know such a distinction, i.e. which design objects have impact on success and which ones do not. Knowledge about the success impacts of design objects is a very valuable 'side-effect' of our approach. The appropriate empirical analysis technique depends on shape of the maturity model (hierarchical or not, etc.), the success factors (one or several), and according hypotheses. In many cases regression analyses (e.g. MANOVA) might be recommended, using the design objects (whose national specificity is to be tested) as the independent variables and the success factors as the dependent variables. Comparing the results for both countries allows building the aforementioned classification of design objects.

Calibration of the maturity model

To make the overall maturity level of organizations comparative for both countries, the maturity model for the second country has to be recalibrated if national specific design objects were found. Calibration, i.e. the assignment of characteristics of a design object to a maturity level, can be done in several ways: 1) By argumentation (reasoning or literature review, etc.) or according to an existing maturity model like the CMM, 2) by empirical means, e.g. the Rasch calibration (cf. Dekleva et al. 1997), or 3) by the impact of the design object on the success of the maturity

model domain and/or the organizational success. The third approach seems obvious – however, according to our literature research, it is surprisingly not used. The analysis results support the first and especially the third approach, since the success perspective was included in the empirical analysis. They should gain insight which maturity level in the second country is equivalent to which maturity level in the first one in relation to their impact on success. Consequently, the main outcome of this phase is an adapted and comparative model for the second country.

Exemplary application of the extension phases

As every BI maturity model is different, it is infeasible to unilaterally confirm the hypotheses. If, however, we can make evident the impact of national culture on some essential BI design objects (that are part of most BI maturity models), then it is legitimate to generalize this finding for BI maturity models. Consequently, we would then assume that BI maturity models are affected by national culture.

biMM

We have chosen the BI maturity model biMM (Chamoni et al. 2004) for our exemplary application. The reasons were 1) biMM provides an assessment instrument which takes the success perspective into account as well, 2) it claims to be comprehensive (a comparison with other BI maturity models demonstrates that it includes most BI design objects - a more detailed analysis is beyond the scope of this paper) and 3) it is well-known and widely used in one of the two considered countries (Germany). It was developed in corporation of industry and academia and first published in 2004. Between 2004 and 2008 rather marginal adaptations were done, before a fundamental revision in 2009 has been undertaken, considering new BI trends and checking biMM against other BI maturity models and frameworks to ensure comprehensiveness, i.e. to include all relevant BI design objects. biMM is made up of three dimensions (functionality, technology, organization). Each dimension consists of several categories which can be further divided into BI design objects. Table 2 includes the dimensions, categories, and BI design objects.

Hypotheses about the impact of national culture on BI design objects

Generating the hypotheses about potentially national specific BI design objects requires an extensive literature review, as the hypotheses should be based on consolidated prior research findings. In the face of the broad spectrum of BI design objects in biMM we abstain from such a comprehensive analysis in the paper at hand. Instead we base the hypotheses exemplarily on the Hofstede indices to illustrate the underlying idea. Once again, usually this phase requires a detailed analysis based on all relevant references for all BI design objects. As already mentioned the most used and known contribution about national culture are Hofstede's indices. The Uncertainty Avoidance Index (UAI) describes the degree to which members of a society feel comfortable with uncertainty and ambiguity. The Power Distance Index (PDI) describes the extent to which the less powerful members of organizations and institutions accept and expect that power is distributed unequally. The Masculinity Index (MAS) expresses to what extent a national culture is characterized by masculine relative to feminine values. The Individualism Index (IDV) describes the extent to which people of a country show a propensity to see themselves as self-sufficient individuals (individualist) as compared to a propensity to see themselves primarily as an integral part of a social group (collectivist). Finally, the Long Term Orientation (LTO) addresses the fact that societies that take a long-term perspective primarily emphasize doing things that improve the future whereas short-term societies will emphasize the present. According to Hofstede only two of those index values are significantly different for the US and Germany, namely for IDV (91 for the US and 67 for Germany on scale from 6 to 91 for all countries) and UAI (46 for the US and 65 for Germany on scale from 8 to 112). In our example we concentrate on these two indices. A comprehensive analysis should check the other indices as well, even if their impact is lower according to Hofstede's findings. In addition, further general findings about national culture impact like (Aguilera et al. 2003) and specific insights for certain BI design objects should be considered.

Table 2 summarizes the hypotheses we formulate for the biMM design objects (not written out in text due to space limitations). As soon as at least one national culture factor is supposed to have impact on a design object we regard this design object as national specific. The table contains for each country (US and G = Germany) hypotheses if and how the BI design objects are influenced by the two indices IDV and UAI. If an index is supposed to have a positive effect on a certain design object it is marked by '↑', a negative effect is marked by '↓'. If we do not hypothesize an

impact of IDV or UAI on a design object the cell is left empty. Some example illustrate how to read the table and how the hypotheses might be supported beyond Hofstede by prior research. Hofstede argues that high values for the uncertainty avoidance index (UAI) (stated, e.g., in Germany) express "an emotional need for rules" which can be transferred to a bias for standardized processes that follow pre-defined and transparent patterns. Consequently, we expect that German organizations prefer well elaborated and standardized BI processes, e.g. for project management and service management (category 'BI processes in dimension 'organization') (Palvia et al. 1996). On the other hand, several studies already investigated that a high UAI value is negatively correlated with the adoption of new technologies (e.g Johns et al. 2002). Therefore, we expect that design objects addressing maturity about new BI technologies (e.g operational BI, advanced analytics etc. – cf. categories 'technical architecture' and 'data management' in dimension 'technology') are influenced by this national culture factor. Both hypotheses are supported by extensive prior research about IT development, adoption, diffusion, and use in different countries; an overview of related literature can be found in (Kappos et al. 2008; Leidner et al. 2006; Myers et al. 2002).

Table 2. BIMM design objects and national culture factors

Dimension	**Category**	**BIMM Design object**	**IDV**		**UAI**	
			US	**G**	**US**	**G**
Functionality	Scope	Diffusion in corporate departments				
		Diffusion in application areas / business processes				
		Provisioning of needed data				
	Data architecture	Data homogenization	↓			
		Data redundancy	↓			
		Data quality management				
		Meta data management				
		Integration of external data				
	Penetration level	Sharing of analytical information	↓			
		Acceptance of BI	↓			
Technology	Technical architecture	Data Warehouse architecture				
		Tool and architecture standardization	↓			
		Operational BI				↓
	Data management	Data integration				↓
		Data quality management				
		Meta data management				
		Master data management				
	Information design	Analysis functionality				↓
		Information channels				
		Report automation				
Organization	BI strategy	BI strategy				↑
	BI organization structure	BI governance	↓			↑
		BI organizational structure	↓			
		Data ownership				
	BI processes	Project methodology				↑
		Requirements management				↑
		Service management				↑
		BI operations				
		System availability				
	Profitability	Profitability calculation model				↑
		Profitability calculation time				
		Cost allocation				↑

Another example how the hypotheses in the table can be supported is the impact of UAI on (BI) governance. A high UAI value can be expected to score high on (BI) governance maturity because of its tendency to require certainty – this assumption is supported by several references, e.g. (Silvius 2008; Sornes et al. 2004).

Data collection

The research project is currently in the data collection phase. The original questionnaire as the measurement instrument has been written in German. To measure the success of design objects in the maturity domain (i.e. BI), we come back to the often-cited claim of BI "to support the right information at the right time" (which is adapted from logistic management) and to its inherent purpose to be the basis for all decisions in the organization. Accordingly, questions about the following success factors were included in the questionnaire (to assess on a Likert scale from 1 to 5): 1) All necessary information required to support the decision-making is available. 2) Analytical information is available at the right time. 3) Decisions are made on the basis of analytical information.

Pretests with BI experts were conducted to assure understandability. After translating the questionnaire into English further pretests were conducted to ensure the aforementioned measurement equivalence across countries. We already experienced some national culture issues during this translation phase, e.g. when transferring characteristics of design objects for the BI organizational structure into a foreign language. After some iterations, the questionnaire could be distributed to organizations. The data has been collected in Germany first. Currently about 55 completed questionnaires can be used for the analysis. Data in the US is presently collected, to date about 15 questionnaires have been turned in. We are currently conducting analyses on the German data. As soon as sufficient US data is available, we will extend the investigations to both countries. Consequent activities will follow the steps as described in the previous section.

Implications

As soon as the hypotheses for essential BI design objects are supported, we regard the overall assumption confirmed that national culture affects BI maturity models. In such a case we might conclude the following implications. Those are not limited only to a methodology to make (BI) maturity models applicable in an international setting. In the context of BI the research findings might also provide guidance how to plan and prioritize BI activities based on the knowledge which BI design objects might have most impact on the success of a BI solution. In addition, the results can support organizations in the design of multinational BI solutions and help answer the question if and regarding which topics cross-national standardization and centralization of processes, organizational structures, architectures, etc. are advised versus diversity and decentralization of those BI design objects between different countries. We believe that our research encourages future maturity model design approaches to consider potential contingency factors in general, but also national culture, especially if the maturity model is intended for international use. The research results might also emphasize the relevance of integrating the success perspective during the evaluation phase. Most models claim implicitly that high maturity leads to high organizational performance, however, very few accept the challenge of empirical validation. Finally, our approach has promise for addressing the limitations of prior research on cultural aspects of the IS discipline.

Conclusions

The motivation of our research is two-fold. On the one hand, we see the need to extend previous maturity model design with national specificity aspects. On the other hand we are particularly interested in the impact of national culture on BI maturity models. The special position of BI within the IS landscape requires that organizations can rely on assessment results of their BI maturity based on such a maturity model, especially if future development paths are derived from those findings. We think that our research might contribute to both challenges significantly.

Our current work includes some limitations. The approach currently focuses on national culture as the dominant contingency factor. Other context factors like industry and company size might require a similar procedure. The empirical analysis as described in the second extended phase has to make sure that potential side-effects because of these contingency factors don't impact the results and findings. However, we consider our methodology approach general enough to be transferred and to be used to identify other contingency factors and their potential impact on success as well. Both, the description of the extended development framework and the application of the phases to

an existing BI maturity model are based on a two country comparison. Including more countries might increase the complexity significantly. In such a case it might be advisable to identify clusters with 'similar' countries (with the help of previous work). Finally, the current study set-up is based on US and German data. Potentially, other country combinations are characterized by more significant differences (which make the national specificity more obvious). But in the face of many organizations operating in the US and Middle Europe the set-up of our study is motivated as well.

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